CHAPTER 11: UTILITY IMPACTS ANALYSIS

11.1 SUMMARY

The effects of proposed central air conditioner and heat pump energy-efficiency standards on the electricity and gas industries were analyzed using a variant of U.S. DOE/EIA's National Energy Modeling System (NEMS) called NEMS-BRS, together with some exogenous calculations.[a] NEMS was used by DOE/EIA to produce the *2000 Annual Energy Outlook* (*AEO2000*),[1] and NEMS-BRS is used to provide some key equivalent inputs to our standards analysis. Because electric utility restructuring is well underway, it is no longer valid to assume the traditional cost recovery regulation of utilities. Therefore, this utility analysis consists of a comparison between model results for a case comparable to the *AEO2000* Reference Case, as reported in the *AEO2000*, and policy cases incorporating each of the central air conditioner and heat pump trial standard levels. Because the policy standards effects are too small to be seen in the context of the whole electricity sector, NEMS-BRS is not used directly. Rather, exploratory runs are conducted to estimate marginal effects, which are then used to calculate the small effects on utilities due to each proposed trial standard level. The reduced electricity demand from all five standards reduces generation from both coal and natural gas. Because natural gas is more frequently the marginal fuel, it is usually affected to a greater degree, particularly early in the forecast period. Other generation is only minimally affected by any of the trial standard levels.

11.2 PURPOSE OF THE ANALYSIS

The purpose of this analysis is to assess the impact of each trial standard level for both central air conditioners and heat pumps on electric utilities. The requirement that the effects of proposed standards on electric utilities be analyzed has a long history. Analysis of the effects of proposed standards on the electric utility industry historically took the form of estimated fuel savings and capital cost savings relative to the likely reduction in revenues implied by lower electricity sales. In the short term, ratepayers of traditional utilities gained because of reduced energy use at fixed prices, but any imbalance between utility revenue and costs disappeared in the long run as cost recovery regulation ensured that utilities would recover their costs. In a restructured industry, however, only transmission an d distribution providers will be permitted to recoup costs, and energy prices are not rigid in the short run, so the basis of our analysis must change. Using the *AEO2000* assumptions regarding the spread of restructuring allows us to use NEMS-BRS to estimate the

[a] For more information on NEMS, please refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is *National Energy Modeling System: An Overview 2000*, DOE/EIA-0581(2000), March 2000. DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because our analysis entails some minor code modifications and the model is run under policy scenarios that are variations on DOE/EIA assumptions, the name NEMS-BRS refers to the model as used here (BRS is DOE's Building Research and Standards office, under whose aegis this work has been performed).

overall effect of standards on the industry.[b] We assess the impact of standards on utilities by reporting several key industry parameters, notably energy sales, generation, and capacity.

11.3 ASSUMPTIONS

NEMS-BRS has several advantages that have led to its adoption as the source for basic forecasting in the appliance energy-efficiency analyses. NEMS-BRS relies on a set of assumptions which are well known and fairly transparent due to the exposure and scrutiny each *AEO* receives. In addition, the comprehensiveness of NEMS-BRS permits the modeling of interactions among the various energy supply and demand sectors and the economy as a whole, so it produces a sophisticated picture of the effects of appliance standards. Perhaps most importantly, because it explicitly simulates the impact on the industry, NEMS-BRS provides an accurate estimation of marginal effects, which yield better indicators of actual effects than estimates based on industry-wide average values. We chose marginal rates over average rates because we wanted to show the effects of proposed standards as well as what might also be happening in the market according to the *AEO2000* Reference Case.

The utility analysis uses the assumptions of *AEO2000* and treats central air conditioner and heat pump efficiency standards as variations in policy. Because the implementation of standards reduces demand by less than 1.5% of total U.S. electricity generation in any given year, its effect cannot be detected directly by simulations. Therefore, simulation runs are done for larger reductions in demand, and results are interpolated between *AEO2000* and these runs. We assume that the effects measured are linear within the range of interpolation. This issue is discussed further below and in Appendix H.

Variations in some of these assumptions have also been explored through two scenarios that represent alternative futures based on the Low and High Economic Growth cases of *AEO2000*, demonstrating the effects of alternative growth assumptions on energy markets. The growth assumptions for each case are based on macroeconomic forecasts prepared by DRI/McGraw-Hill. The *AEO2000* Reference Case assumes a moderate rate of economic growth, 2.2% a year from 1998 through 2020. The Low Economic Growth case is based on lower growth rates for population, labor force, and productivity, resulting in higher prices and interest rates and lower growth in industrial output. Economic output in the Low Growth case increases by 1.7% a year from 1998 through 2020. The High Economic Growth case incorporates higher growth rates for population, labor force, and labor productivity, resulting in lower inflation and interest rates and an increased projected economic output of 2.6% a year. The energy savings that we used to model the Low and High Economic Growth cases varied by a minor amount from that which we used to model the standard levels in the Reference Case.[c]

---

[b] The DOE/EIA assumptions regarding restructuring are explained on page 11 and pages 20-23 of the *AEO2000*.

[c] Please see pages 38 and 49 of the *AEO2000* for more details on growth assumptions.

11.4 METHODS

NEMS is a large, multi-sectoral, partial equilibrium model of the U.S. energy sector that has been developed over several years by DOE/EIA, primarily for the purpose of preparing the *Annual Energy Outlook*. NEMS produces a widely recognized baseline forecast for the U.S. through 2020 and is in the public domain. The NEMS-BRS model used for appliance standards analysis is based on the *AEO2000* version of NEMS with minor modifications.

The current time horizon of NEMS-BRS is 2020, yet other parts of the central air conditioner and heat pump energy-efficiency standards analysis extend to the year 2030. It is not feasible to extend the forecast period of NEMS-BRS for the purposes of this analysis nor does DOE/EIA have an approved method for extrapolation of many outputs beyond 2020. While it might seem reasonable in general to make simple linear extrapolations of results, in practice this is not advisable because outputs could be contradictory. For example, changes in the fuel mix implied by extrapolations of those outputs could be inconsistent with the extrapolation of marginal emissions factors. An analysis of various trends sufficiently detailed to guarantee consistency is beyond the scope of this work, and, in any case, would involve a great deal of uncertainty. Therefore, all extrapolations beyond 2020 are simple replications of year 2020 results (except for fuel prices; see below). While these may seem unreasonable in some instances, in this way results are guaranteed to be consistent. As with the *AEO* Reference Case in general, the implicit assumption is that the regulatory environment does not deviate from the current known situation during the extrapolation period. Only changes that have been announced with date-certain introduction are included in NEMS-BRS. To emphasize the extrapolated results wherever they appear, they are shaded in grey to distinguish them from actual NEMS-BRS results.

Fuel price inputs to the analysis of standards are also consistent with NEMS-BRS. We extrapolate to 2030 using the DOE/EIA approach for forecasting fuel prices for the U.S. Federal Energy Management Program (FEMP). To determine the regional price forecasts for petroleum products for the years 2020-2030, EIA uses the projected average annual growth rate for the world oil price in combination with the refinery and distribution markups from 2020 onward. Similarly, natural gas prices are derived from the average annual growth rate over the years 1998 to 2020 in combination with regional price margins from the year 2020. Electricity prices are kept constant at 2020 levels because it is assumed that the transition to a restructured utility industry will be completed.

The various trial standard level simulation runs are executed by reducing electricity consumption in the NEMS-BRS Residential Demand Module of the NES forecast savings for space heating. For space cooling, the air-conditioning efficiency in NEMS was adjusted to induce a higher cooling energy use decrement. These efficiency adjustments and energy reductions are applied to the central air conditioner and heat pump end uses, respectively, and are divided among U.S. census divisions based on the prevalence of central air conditioning and heat pumping as determined by DOE/EIA's *Residential Energy Consumption Survey* (RECS).[2]

As mentioned above, the magnitude of energy decrements that would be required for NEMS-BRS to produce stable results safely out of the range of numerical noise is larger than even the most rigorous efficiency standard under consideration. Therefore, we estimate results in the range of effects of the standard levels using interpolation. Reductions to the residential central air conditioner and heat pump load are implemented at levels well beyond the range of effects of the proposed standards. Actual changes in generation and capacity due to the standard are then derived from these outputs. A detailed description of the interpolation methodology is given in Appendix H.

11.5 RESULTS

Table 11.1 shows the results from a NEMS-BRS run comparable to the published *AEO2000* Reference Case, with results for the five trial standard levels presented in Tables 11.2 through 11.6. Tables 11.7 and 11.8 represent alternative Roll-up and Shift *efficiency scenarios* to trial standard level 3 (NAECA *efficiency scenario*), respectively. For more information on these *efficiency scenarios*, please refer to Chapter 7. Each table shows forecasts using interpolated results as described in Section 11.4 for residential energy sales and total U.S. electric generation and installed capacity. Results are discussed in the following two sections. Within these sections, individual standards are grouped according to the NES-forecast electricity savings patterns. Generally, most standards result in similar effects on electric and gas utilities, although the magnitude of the effects varies according to the level of forecast energy savings. When electricity savings dominate, gas-fired generation is somewhat more affected than coal-fired generation, especially early in the forecast. This effect reflects the more load-following role of gas generation overall.

11.5.1 Central Air Conditioner and Heat Pump Standard Level Results

For each of the five standard levels, residential energy sales fall compared to the *AEO2000 Reference Case*. The decrease in sales is proportional to the amount of energy that the NES model predicts will be saved by each standard level, ranging from just over 0.9% (Standard Level 1) to 4.5% (Standard Level 5) of total residential electricity sales in the peak savings year reported. For each standard level, total U.S. electric generation decreases relative to the *AEO2000* baseline, by just under 1.4% in the peak year of the maximum savings case (Standard Level 5) to 0.3% in Standard Level 1. Total installed capacity is also reduced in each standard level scenario, by a maximum of just under 2.9% (Standard Level 5) in 2020. About 87% of the capacity reduction is in natural gas fired capacity, in this case, reflecting the peaking nature of air conditioning use.

11.5.2 Economic Growth Cases

The results under the Low and High Economic Growth cases are presented for trial standard level 3 in Tables 11.9 and 11.10, respectively. For the Low Economic Growth trial standard level case, the savings have a slightly lower impact than in their corresponding Reference Cases, while

the High Growth standard level case results in a slightly higher impact for each of the reported industry parameters (i.e., energy consumption, generation, and capacity).

Table 11.1 AEO2000 Reference Forecast

NEMS-BRS Results: AEO2000 Reference

	2000	2005	2010	2015	2020
Residential Sector Energy Consumption[1]					
Electricity Sales (TWh)[2]	1,185	1,281	1,379	1,464	1,553
Natural Gas (EJ)	5.32	5.51	5.76	5.96	6.18
Other (EJ)	1.97	1.91	1.84	1.78	1.74
Natural Gas (Quads)	5.04	5.22	5.46	5.65	5.86
Other (Quads)[3]	1.87	1.81	1.74	1.69	1.65
Total U.S. Electric Generation[4]					
Coal (TWh)	1,930	2,127	2,172	2,251	2,347
Gas (TWh)	601	717	1,001	1,297	1,476
Petroleum (TWh)	90	68	54	47	44
Nuclear (TWh)	688	674	627	511	427
Renewables (TWh)	389	411	429	437	447
Total (TWh)[5]	3,698	3,997	4,283	4,543	4,741
Installed Generating Capacity[6]					
Coal (GW)	315.3	310.6	310.7	315.8	326.0
Other Fossil (GW)[7]	274.8	334.0	404.7	461.8	507.6
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7
Total (GW)[8]	782.3	836.5	901.2	948.8	996.3

[1]Comparable to Table A2 of AEO2000: Energy Consumption, Residential

[2]Comparable to Table A8 of AEO2000: Electricity Sales by Sector

[3]Includes distillate fuel, residential fuel, kerosene, LPG, motor gasoline, coal, and renewable energy

[4]Comparable to Table A8 of AEO2000: Electric Generators and Cogenerators

[5]Excludes "Other Gaseous Fuels" cogenerators and "Other" cogenerators

[6]Comparable to Table A9 of AEO2000: Electric Generators and Cogenerators Capability

[7]Includes "Other Gaseous Fuels" cogenerators

[8]Excludes Pumped Storage and Fuel Cells

Table 11.2 Standard Level 1 Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,375	1,454	1,539	Electricity Sales (TWh)	0.0	0.0	-4.3	-9.8	-14.4	-17.5	-19.5
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,171	2,248	2,341	Coal (TWh)	0.0	0.0	-1.0	-2.5	-6.2	-6.2	-6.2
Gas (TWh)	601	717	998	1,289	1,467	Gas (TWh)	0.0	0.0	-3.0	-8.2	-8.8	-8.8	-8.8
Petroleum (TWh)	90	68	53	47	45	Petroleum (TWh)	0.0	0.0	-0.5	0.2	0.8	0.8	0.8
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	437	447	Renewables (TWh)	0.0	0.0	-0.1	0.2	0.0	0.0	0.0
Total (TWh)	3,698	3,997	4,278	4,533	4,727	Total (TWh)	0.0	0.0	-4.5	-10.3	-14.2	-14.2	-14.2
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.7	315.6	325.2	Coal (GW)	0.0	0.0	0.0	-0.2	-0.8	-0.8	-0.8
Other Fossil (GW)	274.8	334.0	404.2	458.0	502.0	Other Fossil (GW)	0.0	0.0	-0.5	-3.8	-5.6	-5.6	-5.6
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.3	836.5	900.6	944.8	989.9	Total (GW)	0.0	0.0	-0.6	-4.0	-6.4	-6.4	-6.4

Table 11.3 Standard Level 2 Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,371	1,447	1,528	Electricity Sales (TWh)	0.0	0.0	-7.6	-17.2	-25.4	-31.0	-34.6
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,169	2,246	2,337	Coal (TWh)	0.0	0.0	-2.8	-4.5	-10.4	-10.4	-10.4
Gas (TWh)	601	717	997	1,283	1,461	Gas (TWh)	0.0	0.1	-3.8	-13.7	-15.4	-15.4	-15.4
Petroleum (TWh)	90	68	53	47	45	Petroleum (TWh)	0.1	0.0	-1.2	0.2	1.3	1.3	1.3
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	437	447	Renewables (TWh)	0.0	0.0	-0.1	0.1	-0.1	-0.1	-0.1
Total (TWh)	3,698	3,997	4,275	4,525	4,716	Total (TWh)	0.1	0.1	-7.8	-17.9	-24.6	-24.6	-24.6
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.7	315.4	324.7	Coal (GW)	0.0	0.0	0.0	-0.4	-1.3	-1.3	-1.3
Other Fossil (GW)	274.8	334.0	403.9	455.5	498.4	Other Fossil (GW)	0.0	0.0	-0.8	-6.3	-9.2	-9.2	-9.2
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.3	836.5	900.4	942.1	985.7	Total (GW)	0.0	0.0	-0.8	-6.7	-10.6	-10.6	-10.6

Table 11.4 Standard Level 3 Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,370	1,444	1,524	Electricity Sales (TWh)	0.0	0.0	-8.7	-19.9	-29.5	-35.9	-40.2
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,169	2,246	2,335	Coal (TWh)	0.0	0.0	-3.2	-5.2	-12.1	-12.1	-12.1
Gas (TWh)	601	717	997	1,281	1,458	Gas (TWh)	0.0	0.1	-4.4	-15.9	-17.8	-17.8	-17.8
Petroleum (TWh)	90	68	53	47	45	Petroleum (TWh)	0.1	0.0	-1.4	0.2	1.5	1.5	1.5
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	437	447	Renewables (TWh)	0.0	0.0	-0.1	0.1	-0.1	-0.1	-0.1
Total (TWh)	3,698	3,997	4,274	4,522	4,712	Total (TWh)	0.1	0.1	-9.1	-20.7	-28.6	-28.6	-28.6
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.7	315.3	324.4	Coal (GW)	0.0	0.0	0.0	-0.5	-1.6	-1.6	-1.6
Other Fossil (GW)	274.8	334.0	403.8	454.5	496.9	Other Fossil (GW)	0.0	0.0	-0.9	-7.3	-10.7	-10.7	-10.7
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.3	836.5	900.2	941.0	984.0	Total (GW)	0.0	0.0	-1.0	-7.8	-12.3	-12.3	-12.3

Table 11.5 Standard Level 4 Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,368	1,440	1,517	Electricity Sales (TWh)	0.0	0.0	-10.7	-24.5	-36.5	-44.6	-49.9
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,170	2,245	2,332	Coal (TWh)	0.0	0.0	-1.7	-6.0	-15.3	-15.3	-15.3
Gas (TWh)	601	717	993	1,277	1,454	Gas (TWh)	0.0	0.0	-7.8	-19.6	-21.9	-21.9	-21.9
Petroleum (TWh)	90	68	53	47	46	Petroleum (TWh)	0.0	0.0	-1.1	0.3	2.0	2.0	2.0
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	437	447	Renewables (TWh)	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Total (TWh)	3,698	3,997	4,272	4,518	4,706	Total (TWh)	0.0	0.0	-10.7	-24.9	-35.1	-35.1	-35.1
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.7	315.3	324.0	Coal (GW)	0.0	0.0	0.0	-0.5	-2.0	-2.0	-2.0
Other Fossil (GW)	274.8	334.0	403.4	452.9	494.2	Other Fossil (GW)	0.0	0.0	-1.3	-8.9	-13.4	-13.4	-13.4
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.3	836.5	899.9	939.4	980.9	Total (GW)	0.0	0.0	-1.3	-9.4	-15.4	-15.4	-15.4

Table 11.6 Standard Level 5 Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,360	1,419	1,483	Electricity Sales (TWh)	0.0	0.0	-19.2	-45.5	-70.0	-87.7	-99.2
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,167	2,240	2,319	Coal (TWh)	0.0	0.0	-4.8	-11.4	-28.2	-28.2	-28.2
Gas (TWh)	601	717	988	1,261	1,435	Gas (TWh)	0.0	0.0	-13.1	-36.5	-40.7	-40.7	-40.7
Petroleum (TWh)	90	68	52	47	47	Petroleum (TWh)	0.0	0.0	-2.2	0.2	3.2	3.2	3.2
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	438	447	Renewables (TWh)	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Total (TWh)	3,698	3,997	4,263	4,496	4,675	Total (TWh)	0.0	0.0	-20.0	-46.7	-65.7	-65.7	-65.7
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.6	314.8	322.4	Coal (GW)	0.0	0.0	-0.1	-1.0	-3.6	-3.6	-3.6
Other Fossil (GW)	274.8	334.0	402.3	445.4	482.7	Other Fossil (GW)	0.0	0.0	-2.4	-16.4	-24.9	-24.9	-24.9
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.6	Renewables (GW)	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Total (GW)	782.3	836.5	898.8	931.4	967.7	Total (GW)	0.0	0.0	-2.4	-17.4	-28.6	-28.6	-28.6

Table 11.7 Standard Level 3 Roll-Up Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,371	1,445	1,525	Electricity Sales (TWh)	0.0	0.0	-8.4	-19.1	-28.3	-34.5	-38.5
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,170	2,246	2,335	Coal (TWh)	0.0	0.0	-2.5	-4.8	-11.6	-11.6	-11.6
Gas (TWh)	601	717	996	1,281	1,458	Gas (TWh)	0.0	0.0	-5.4	-15.6	-17.7	-17.7	-17.7
Petroleum (TWh)	90	68	53	47	46	Petroleum (TWh)	0.0	0.0	-1.0	0.1	1.5	1.5	1.5
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	437	447	Renewables (TWh)	0.0	0.0	-0.1	0.3	-0.1	-0.1	-0.1
Total (TWh)	3,698	3,997	4,274	4,523	4,713	Total (TWh)	0.0	0.0	-9.0	-19.9	-27.9	-27.9	-27.9
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.7	315.4	324.5	Coal (GW)	0.0	0.0	0.0	-0.4	-1.5	-1.5	-1.5
Other Fossil (GW)	274.8	334.0	403.7	454.8	497.2	Other Fossil (GW)	0.0	0.0	-1.0	-7.0	-10.4	-10.4	-10.4
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.3	836.5	900.2	941.4	984.4	Total (GW)	0.0	0.0	-1.0	-7.4	-11.9	-11.9	-11.9

Table 11.8 Standard Level 3 Shift Forecast

NEMS-BRS Results:						Difference from AEO2000 Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,185	1,281	1,369	1,442	1,520	Electricity Sales (TWh)	0.0	0.0	-9.6	-22.1	-32.9	-40.2	-45.0
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,930	2,127	2,172	2,245	2,334	Coal (TWh)	0.0	0.0	0.3	-5.8	-13.2	-13.2	-13.2
Gas (TWh)	601	717	992	1,280	1,456	Gas (TWh)	0.0	0.0	-8.8	-17.4	-20.3	-20.3	-20.3
Petroleum (TWh)	90	68	53	47	46	Petroleum (TWh)	0.0	0.0	-0.7	0.1	1.6	1.6	1.6
Nuclear (TWh)	688	674	627	511	427	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	411	429	437	447	Renewables (TWh)	0.0	0.0	-0.2	0.3	0.0	0.0	0.0
Total (TWh)	3,698	3,997	4,274	4,520	4,709	Total (TWh)	0.0	0.0	-9.5	-22.9	-31.9	-31.9	-31.9
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	310.6	310.7	315.3	324.3	Coal (GW)	0.0	0.0	0.0	-0.5	-1.7	-1.7	-1.7
Other Fossil (GW)	274.8	334.0	403.6	453.9	495.7	Other Fossil (GW)	0.0	0.0	-1.1	-7.9	-11.9	-11.9	-11.9
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.5	101.7	103.8	105.7	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.3	836.5	900.1	940.4	982.7	Total (GW)	0.0	0.0	-1.1	-8.4	-13.6	-13.6	-13.6

Table 11.9 Standard Level 3 Low Economic Growth Forecast

NEMS-BRS Results:						Difference from AEO2000 Lmac Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,183	1,275	1,358	1,419	1,476	Electricity Sales (TWh)	0.0	0.0	-8.3	-19.0	-28.6	-35.7	-40.5
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,923	2,105	2,132	2,170	2,210	Coal (TWh)	0.0	0.0	-2.3	-2.0	-5.9	-5.9	-5.9
Gas (TWh)	591	683	934	1,183	1,316	Gas (TWh)	0.0	0.0	-5.9	-17.0	-21.4	-21.4	-21.4
Petroleum (TWh)	85	60	42	38	34	Petroleum (TWh)	0.0	0.0	-0.6	0.3	0.4	0.4	0.4
Nuclear (TWh)	688	674	627	511	428	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	388	409	425	433	441	Renewables (TWh)	0.0	0.0	0.0	0.1	-0.3	-0.3	-0.3
Total (TWh)	3,675	3,931	4,160	4,335	4,429	Total (TWh)	0.0	0.0	-8.8	-18.6	-27.2	-27.2	-27.2
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	309.6	308.0	309.4	310.9	Coal (GW)	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.5
Other Fossil (GW)	275.0	325.3	388.0	427.9	461.7	Other Fossil (GW)	0.0	0.0	-1.0	-7.0	-10.9	-10.9	-10.9
Nuclear (GW)	97.5	93.4	84.1	67.4	57.0	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.7	98.3	101.2	103.0	104.4	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.5	826.6	881.3	907.7	934.0	Total (GW)	0.0	0.0	-1.0	-7.1	-11.4	-11.4	-11.4

Table 11.10 Standard Level 3 High Economic Growth Forecast

NEMS-BRS Results:						Difference from AEO2000 Hmac Reference						Extrapolation	
	2000	**2005**	**2010**	**2015**	**2020**		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Residential Sector Energy Consumption						*Residential Sector Energy Consumption*							
Electricity Sales (TWh)	1,183	1,286	1,382	1,465	1,552	Electricity Sales (TWh)	0.0	0.0	-9.3	-20.9	-30.9	-37.6	-42.1
Total U.S. Electric Generation						*Total U.S. Electric Generation*							
Coal (TWh)	1,937	2,159	2,230	2,370	2,607	Coal (TWh)	0.0	0.0	-0.8	-8.9	-22.1	-22.1	-22.1
Gas (TWh)	615	762	1,064	1,360	1,469	Gas (TWh)	0.0	-0.3	-7.6	-13.1	-8.7	-8.7	-8.7
Petroleum (TWh)	95	83	75	65	69	Petroleum (TWh)	0.0	0.0	-1.1	0.0	1.3	1.3	1.3
Nuclear (TWh)	688	674	627	510	440	Nuclear (TWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (TWh)	389	414	435	446	459	Renewables (TWh)	0.0	0.0	0.0	0.1	-0.1	-0.1	-0.1
Total (TWh)	3,724	4,092	4,431	4,751	5,044	Total (TWh)	0.0	-0.3	-9.6	-21.9	-29.6	-29.6	-29.6
Installed Generating Capacity						*Installed Generating Capacity*							
Coal (GW)	315.3	311.2	315.4	330.1	359.3	Coal (GW)	0.0	0.0	0.0	-0.8	-2.7	-2.7	-2.7
Other Fossil (GW)	274.8	340.1	426.7	483.9	519.4	Other Fossil (GW)	0.0	0.0	-1.2	-7.8	-9.8	-9.8	-9.8
Nuclear (GW)	97.5	93.4	84.1	67.4	58.7	Nuclear (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables (GW)	94.9	99.1	102.7	105.1	107.5	Renewables (GW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (GW)	782.5	843.8	928.9	986.5	1,044.9	Total (GW)	0.0	0.0	-1.2	-8.6	-12.5	-12.5	-12.5

REFERENCES

1. U.S. Department of Energy-Energy Information Administration, *Annual Energy Outlook 2000*, December, 1999. Washington, DC. Report No. DOE/EIA-0383(2000).

2. U.S. Department of Energy-Energy Information Administration, *A Look at Residential Energy Consumption in 1997*, 1999. Washington, DC. Report No. DOE/EIA-0632(97). EIA website: <http://www.eia.doe.gov/pub/pdf/consumption/063297.pdf>